

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application for Letters Patent

003780" 98224960

TITLE: LENS UNIT AND CAMERA

INVENTOR(S): KOICHI TAKEUCHI

MASAMI HIMURO

KO ISHIMOTO

SEISUKE OHBA

LENS UNIT AND CAMERA

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a lens unit for use in camera and a camera preferably applied for a video camera, and more particularly to a lens unit preferably used for taking stereoscopic pictures and camera thereof.

Description of the Related Art

Recently, various camera structures have been proposed as the stereoscopic television camera.

In this stereoscopic cameras, there are two-camera type in which a picture for the right eye and a picture for the left eye are taken with two cameras and a single lens type in which pictures for the right eye and left eye are taken with a single camera.

In case of the two-camera type, a stereoscopic image is created by generating a parallax between pictures from the two cameras.

On the other hand, in case of the single lens stereoscopic system, a phenomenon that a parallax is generated in a large lens also is utilized.

Thus, in the single lens stereoscopic system, as shown in FIG. 16, an optical shutter 53 for shielding the divided right and left portions are provided in front of a lens 52 of

is limited, for example, the zoom range has to be narrowed.

Thus, it is difficult to apply the zoom function to the stereoscopic camera.

SUMMARY OF THE INVENTION

To solve the above described problem, the present invention intends to provide a lens unit and camera capable of achieving both the stereoscopic television function and the zoom function at the same time.

To achieve the above described object, according to an aspect of the present invention, there is provided a lens unit comprising: at least a lens including a zoom lens; a light quantity adjusting means; an electronic optical shutter provided on a subsequent stage of the zoom lens; and an optical shutter driving portion for controlling the electronic optical shutter to an opening of a predetermined pattern.

Further, according to another aspect of the present invention, there is provided a camera comprising: at least a lens including a zoom lens; a light quantity adjusting means; an electronic optical shutter provided on a subsequent stage of the zoom lens; and an optical shutter driving portion for controlling the electronic optical shutter to an opening of a predetermined pattern.

According to the structure of the present invention, because the electronic optical shutter is provided on a subsequent stage of the zoom lens, a screen edge is never

FIG. 6A, B are diagrams showing another example in which the light quantity adjusting means of the liquid shutter is operated;

FIG. 7 is a diagram showing still another example in which the light quantity adjusting means of the liquid shutter is operated;

FIG. 8 is a diagram showing schematically a relation of disposition between a mechanical shutter if provided and the liquid shutter;

FIGS. 9A-D are diagrams showing an example in which the mechanical diaphragm is provided;

FIG. 10 is a diagram showing another example in which the mechanical diaphragm is provided;

FIG. 11A and 11 B is a diagram showing still another example in which the mechanical diaphragm is provided;

FIG. 12 is a diagram showing an example in which the filter is used as the light quantity adjusting means;

FIG. 13 is a diagram showing another example in which the filter is used as the light quantity adjusting means;

FIGS. 14 are diagrams for explaining a case in which a deviation between right and left pictures is changed;

FIGS. 14A is a diagram showing a case in which a focused position is near the camera;

FIG. 14B is a diagram showing a case in which the focused position is far from the camera;

0964296 : 081800

FIG. 15B is a diagram showing a case in which the focused position is far from the camera;

FIG. 17 is a diagram showing a phenomenon that ends of a screen in the stereoscopic camera of FIG. 16 are missed.

The present invention concerns a lens unit comprising at least a lens including a zoom lens, a light quantity adjusting means, an electronic optical shutter provided on a subsequent stage of the zoom lens, and an optical shutter driving portion for controlling the electronic optical shutter to an opening of a predetermined pattern.

Further, the lens unit of the present invention includes a diaphragm for changing the size of an opening mechanically by means of the light quantity adjusting means.

Still further, the lens unit of the present invention includes a filter as the light quantity adjusting means.

In the lens unit of the present invention, the electronic optical shutter is disposed in the vicinity of the

096436 : 08.13.00

In the lens unit of the present invention, its predetermined pattern can be changed alternately between a pattern having an opening at the left side and a pattern having an opening at the right side.

In the lens unit of the present invention, the electronic optical shutter acts as a light quantity adjusting means at the same time.

The present invention concerns a camera comprising at least a lens including a zoom lens, a light quantity adjusting means, an electronic optical shutter provided at a subsequent stage of the zoom lens and an optical shutter driving portion for controlling the electronic optical shutter to a predetermined opening.

8

the present invention.

the left eye is taken by opening a shutter 6B for the left eye image. Consequently, a difference of position between the right eye image and left eye image moves like the parallax of the eyes.

Because the liquid shutter 6 is disposed at the position where the diaphragm is originally located, even only half optical path of the divided shutter portion enables to secure a full screen without any chipping of the right and left images.

Thus, if the liquid shutters 6A and 6B are driven so that the right half R and the left half L are switched so as to allow light to pass through alternately for each field, both the left image and the right image are obtained in each vertical scanning period (1 V).

Here, an object located at an unfocused position becomes a blurred image on an image pickup plane.

By switching the right and left halves of the liquid shutter 6, a blurred image on the right half of the zoom lens 4 and a blurred image on the left half can be separated from each other.

Even a difference in position between the blurred images provides sufficient stereoscopic parallax information.

For example, even a 12-power lens for 2/3 inch is capable of securing a parallax of about 10-15 mm.

Although a distance between human eyes is 60-65 mm, even a parallax which is 1/4 thereof or less provides a sufficient

0904236 : 081800

According to this embodiment, no ordinary diaphragm mechanism is provided, and instead, the liquid shutter 6 functions as the light quantity adjusting means at the same time.

Particularly if the liquid shutter 6 is constructed of fine matrix-like pixels 11 as shown in FIG. 2 and each pixel is driven separately, a desired opening pattern can be formed. Thus, the size of the opening pattern can be changed easily so as to adjust the incident light quantity.

Therefore, for example, the two opening patterns can possess an overlapping portion. Particularly, if the liquid shutter 6 is constituted of such fine matrix-like pixels 11 as shown in FIG. 2, an opening pattern having the overlapping portion can be obtained easily.

telescopic photography is intensified. Conversely, such a pattern, which facilitates to secure the parallax, is employed as a degree of the wide angle photography whose focal distance is short is intensified.

FIG. 5 shows a case in which actually the light quantity adjusting means is actuated by the liquid shutter 6.

In FIG. 5, two opening patterns 13A, 13B are variable in size so that the incident light quantity is also variable.

FIG. 5A indicates a full opening condition. The opening patterns 13A, 13B are semi-circles which are obtained by dividing the same circle as FIG. 3A to two sections. FIG. 5B indicates a state in which the incident light quantity is squeezed a little. There is a closed portion 13X between the two opening patterns 13A and 13B, which does not allow light to pass through.

FIG. 5C indicates a state in which the incident light quantity is squeezed to some extent. The closed portion 13X occupies largely so that small opening patterns 13A, 13B exist on the right and left ends.

By changing the sizes of the opening patterns 13A, 13B as described above, the incident light quantity can be changed.

Preferably, it is so constructed to provide the camera with an exposure meter or the like so that the size of the opening pattern of the liquid shutter 6 is changed automatically or manually corresponding to a measured value to adjust the

incident light quantity.

In the meantime, it is permissible to change three opening patterns shown in FIGS. 5A-5C gradually or it is also permissible to change the size of the opening pattern including middle opening patterns of these continuously.

FIG. 6 shows other example of the operation of the light quantity adjusting means by the liquid shutter 6.

FIG. 6A shows a case of a large opening. Right and left opening patterns 14A, 14B are large opening patterns near semi-circle. There is a closed portion 14X between the two opening patterns 14A and 14B, which does not allow light to pass through. FIG. 6B indicates a case of a small opening. Gravity center positions of the right and left opening patterns 14A, 14B are substantially the same as FIG. 6A.

In this case also, an intermediate condition between FIG. 6A and 6B is possible and the size of the opening can be changed continuously.

FIG. 8. Then, the light quantity adjusting means 20 and the liquid shutter 6 are disposed between the first lens group 5 and the second lens group 7 shown in FIG. 1, that is, at a position where an ordinary diaphragm mechanism should be disposed.

Then, the incident light quantity to the liquid shutter 6 is regulated by an opening 20a provided on the light quantity adjusting means 20.

FIG. 9A indicates a full opening condition, in which the shield plates 21a-21d are located out of the liquid shutter 6.

FIG. 9D indicates that the shield plates are closed most and the four shield plates 21a-21d overlap each other most so

that most part of the liquid shutters 6A, 6B are hidden.

By incorporating the solid image pickup device 8 in the camera 1 shown in FIG. 1, the shutter can be operated by a driving of the solid image pickup device 8. Therefore, the mechanical diaphragm does not always have to be closed fully unlike the film type camera.

Further, because the camera mentioned in the present invention is used mainly as a video camera, its picture-taking operation can be turned on/off with a switch, button or the like. Therefore, it is possible to produce a state having no incident light quantity even if the mechanical diaphragm is not closed fully.

Next, other embodiment of the mechanical diaphragm will be described below.

In this mechanical diaphragm, openings are formed in a rotary or slidable part and then by moving this part, the openings are variable.

In FIG. 10, three openings 23a, 23b, 23c are formed in the rotary disc-shaped part 23 and by rotating this part 23 around an axis thereof, the three openings 23a, 23b, 23c are switched over.

According to the opening pattern of the liquid shutter 6 in this case, two opening patterns 6A, 6B produced by cutting a circle with respect to the center thereof as indicated by dotted line are indicated alternately. A first opening 23a is

substantially fully open and this opening is relatively smaller than the liquid shutter 6 (6A, 6B).

In a second opening 23b, about 1/3 of the liquid shutter 6 is hidden.

A third opening 23c is a smaller opening than the second opening 23b.

FIG. 11 shows an embodiment in which an opening is formed in a slidable part 24. In FIG. 11A, three openings 24a, 24b, 24c each having the same shape as FIG. 10 is formed in the slidable part 24. By sliding this part in an arrow direction, the three openings 24a, 24b, 24c are switched over.

In FIG. 11B, an opening 25d having the same shape as the second opening 23b of FIG. 10 is formed and then, by sliding this part 25 in an arrow direction, either a condition in which about 1/3 of the liquid shutter 6 is hidden by this opening 25d or a fully open state in which the part 25 is removed from before the liquid shutter 6 is selected.

Next, an embodiment in which the filter is used as the light quantity adjusting means will be described below.

FIG. 12 schematically shows a case in which the filter 26, for example, the ND filter is provided just in front of the liquid shutter 6. Light passing through the filter 26 enters the respective parts 6A, 6B of the liquid shutter 6.

By attaching or removing the filter 26 or replacing with another filter having a different transmittance, the light

quantity can be changed.

FIG. 13 schematically shows a case in which the polarizing filter, for example, the polarizing ND filter is employed. Two polarizing filters 27, 28 each having a polarizing direction as indicated by an arrow are used such that they overlap each other. In this case, by adjusting an angle θ produced by the polarizing directions of the two polarizing filters 27, 28, for example, by rotating at least one of the polarizing filters, the incident light quantity can be changed.

Because ordinarily, the polarizing plate is provided on the liquid shutter 6, it is permissible to so construct that one of the two polarizing filters 27, 28 of FIG. 13 is used as the polarizing plate of the liquid shutter 6.

In the meantime, the filter 26 and polarizing filters 27, 28 do not always have to be disposed near the liquid shutter 6 unlike the mechanical diaphragm and instead, may be disposed before or after the zoom lens 4. At least in the construction shown in FIG. 1, the filter may be incorporated within an optical system in front of the solid image pickup device 8.

Next, an embodiment in which an electronic shutter composed of the solid image pickup device 8 is employed as a light quantity adjusting means will be described below.

If for example, a CCD solid image pickup device is employed as the solid image pickup device 8, unnecessary charge can be discharged to a substrate or a vertical CCD register by

operating the electronic shutter so as to reduce accumulation time of a signal charge thereby making it possible to accelerate shutter speed.

If this is applied, the signal charge to be accumulated can be reduced by shortening the accumulation time, so that the same effect as when the incident light quantity is reduced by an ordinary light quantity adjusting means is produced.

Therefore, by changing a time interval of drive pulse which specifies the accumulation time, the incident light quantity can be changed.

Other solid image pickup device, for example, MOS type solid image pickup device, is capable of securing the same effect by achieving the electronic shutter operation in the same manner.

If the opening pattern of the liquid shutter 6 is made variable as described above, when it is intended to take pictures while moving from a light place to a dark place or from a dark place to a light place, the degree of the diaphragm can be changed continuously to correspond to changes of brightness.

Particularly if the liquid shutter 6 composed of the matrix-like pixels 11 is used, a finer degree of the diaphragm can be changed continuously as shown in FIG. 2.

Even if the mechanical diaphragm is used as the light quantity adjusting means, with the configuration shown in FIG. 9, the incident light quantity can be changed smoothly and

continuously by rotating the four blade-like shield plates 21a-21d.

Further, if the filter is employed as the light quantity adjusting means, with the configuration shown in FIG. 13, the incident light quantity can be changed continuously and smoothly by rotating the two polarizing filters 27, 28 to change the angle θ produced by the polarizing directions. If the electronic shutter by the solid image pickup device 8 is employed as the light quantity adjusting means, the time interval of the pulse for the operation of the electronic shutter may be changed and therefore, the incident light quantity can be changed relatively easily.

Therefore, the zoom lens 4 can be used in entire zoom rate region from a wide angle side to a super telescopic side, like an ordinary camera, and thus, a stereoscopic photography can be carried out by the same handling for the ordinary camera.

00000000000000000000000000000000

00000000000000000000000000000000

[illegible]

00000000000000000000000000000000

[illegible][illegible]

In this case, it is permissible to use the same speed (double speed) for storage into a memory or display of pictures. Alternatively, it is also permissible to convert to a single time speed and record with a VTR adapted for two screens.

3) A progressive camera is used for taking pictures.

This progressive camera scans all lines successively and therefore is different from an ordinary field scanning in which odd lines are scanned to obtain odd fields and after that, even lines are scanned to obtain even fields.

Then, the left image and right image are switched over every 1/60 seconds.

Reproduction is carried out at the same speed.

4) Upon taking pictures, a so-called high-vision specified (1125 lines) camera is used. A field is scanned in 1/60 seconds such that half of 1125 lines is scanned. The left and right images are switched over corresponding to each field.

For reproduction, the same high vision specified reproduction unit (VTR or the like) is used.

5) In this case also, the so-called high vision specified camera is used for taking pictures.

Thus, like 4), a field is scanned in 1/60 seconds such that half of 1125 lines is scanned. At the same time, the left image and right image are switched over corresponding to each field.

In this case, two ordinary NTSC specified (525 lines)

000130 " 98224960

091000

Because the single-lens stereoscopic system is employed

stereoscopic camera 1 of this embodiment, it is possible to apply the structure of the stereoscopic television reproduction unit (disclosed in Japanese Patent Application Laid-Open No.SH064-22187) previously proposed by this inventor.

In this stereoscopic television reproduction unit, the right and left images taken according to the conventional single-lens stereoscopic system shown in FIG. 16 are deviated by a predetermined amount, that is, a distance between the human eyes or about 1/3 that distance and displayed.

By displaying (reproducing) the right and left images by deviating relative to each other, it is inhibited to display a distant view on a deeper side or display an object nearer the camera than a focal point such that it is projected unnaturally from a screen, so that the obtained image can be a natural stereoscopy.

Further, it is possible to so construct that the deviation amount of the right and left images corresponds to a state of a camera focus position. This case will be explained with reference to FIGS. 14, 15.

More specifically, if the focal point is near the camera, the deviation amount Δ is a small value Δ_1 as shown in FIG. 14A.

On the other hand, if the focal point is far from the camera, the deviation amount is a large value $\Delta 2$ as shown in FIG. 14B.

090412Z 081000Z

Alternatively, if it is intended to display the right and left images using a display unit (projector, TV monitor or the like) capable of switching over the polarizing angle by means of the liquid shutter, for example, the signals for the right and left images are deviated to each other electrically and the liquid shutter is switched over by a signal for identifying the right and left images, and then, a produced image is seen with the polarizing glasses.

30

03-1600

If the PLZT is employed, the PLZT layer is sandwiched by transparent electrodes and the transparent electrodes are further sandwiched by polarizers.

0964666-081000

According to the present invention, a chipping of an image on the wide angle side of the zoom lens can be suppressed by providing with the electronic optical shutter on a subsequent stage of the zoom lens.

Further, because according to the present invention, the single-lens stereoscopic system is employed, the parallax is not so large, so that images which do not tire the eyes can be obtained.

35

Having described preferred embodiments of the invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments and that various changes and modifications could be effected therein by one skilled in the art without departing from the spirit or scope of the invention as defined in the appended claims.

008120" 9824960